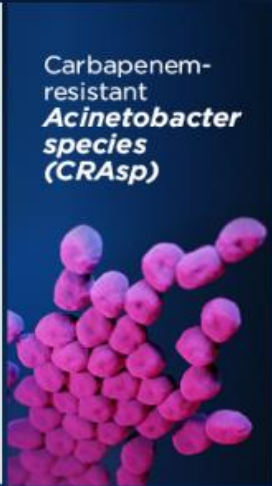


MDRO Reporting and Investigation in Michigan

6 of the 18 most alarming **antibiotic resistance threats** cost the U.S. more than **\$4.6 billion annually**



Vancomycin-resistant
Enterococcus
(VRE)



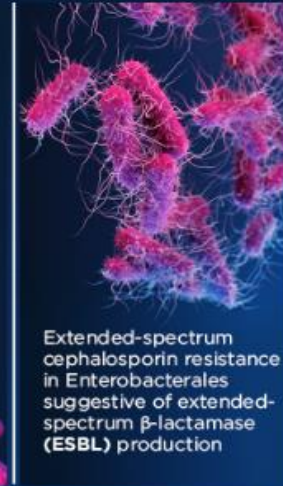
Carbapenem-resistant
Acinetobacter
species
(CRAsp)



Methicillin-resistant
Staphylococcus
aureus (MRSA)



Carbapenem-resistant
Enterobacterales
(CRE)



Extended-spectrum
cephalosporin resistance
in *Enterobacterales*
suggestive of extended-
spectrum β -lactamase
(ESBL) production



Multidrug-resistant (MDR)
Pseudomonas
aeruginosa

www.cdc.gov/DrugResistance



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

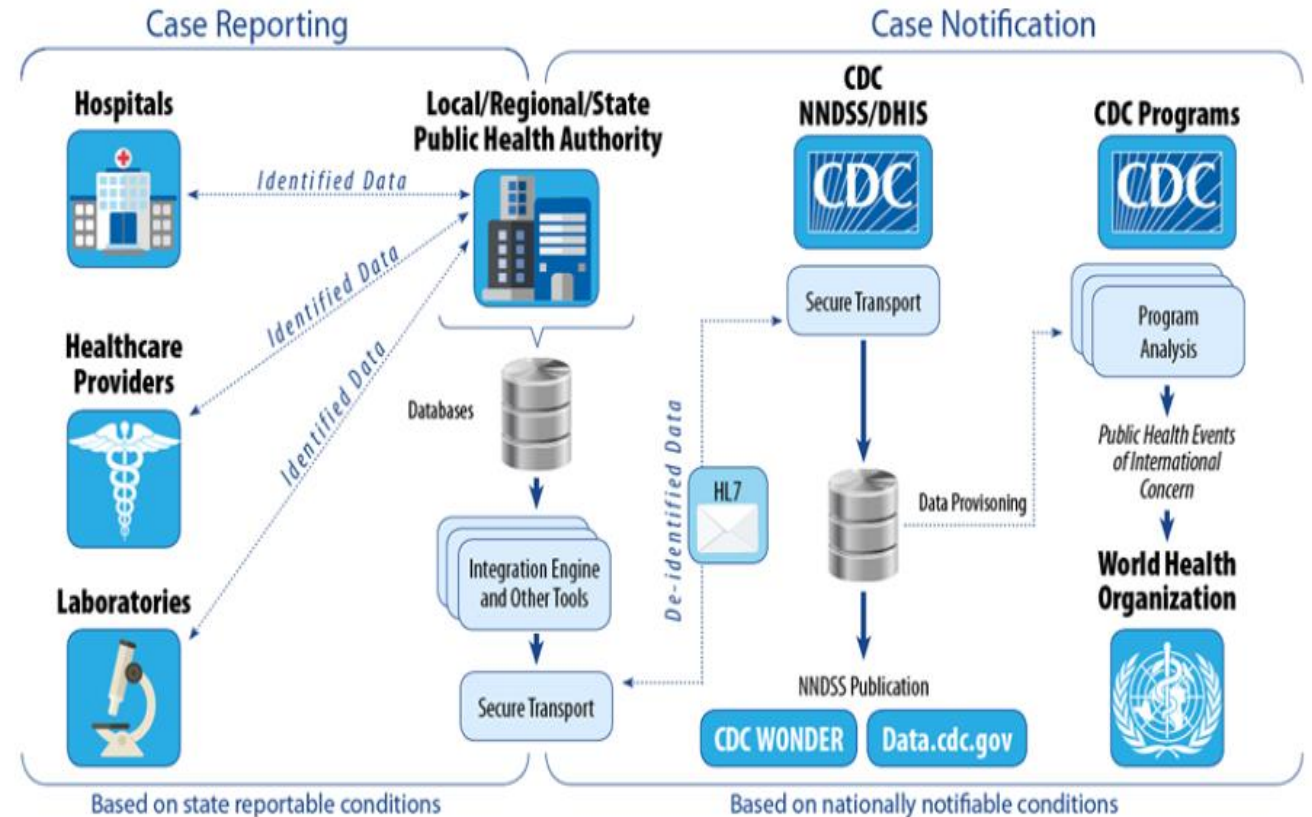
Niki Mach, MPH, CPH, MT(ASCP)

Surveillance for Healthcare-Associated and Resistant Pathogens (SHARP) Unit

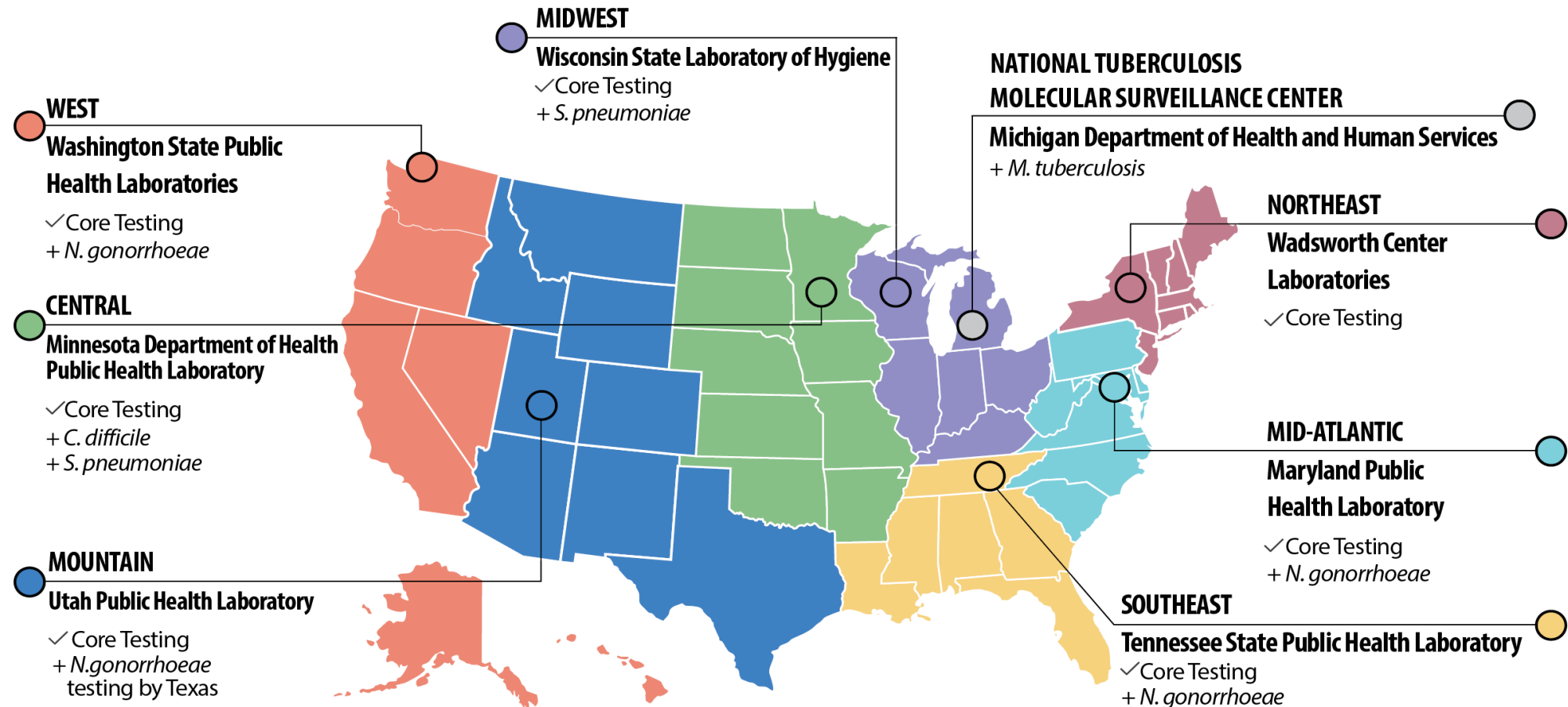
Michigan Department of Health and Human Services

Reportable Diseases in Michigan

- Michigan Disease Surveillance System (MDSS) is the state database for collecting surveillance data.
 - Web-based communicable disease reporting system
 - Cases can be reported by:
 - Electronic laboratory report (ELR)
 - Manual case entry
- Required case reporting to MDSS by healthcare providers and laboratories
- [Surveillance case definition](#) endorsed by CSTE/CDC, nationally notifiable
 - Not used for clinical diagnosis/management



Antibiotic Resistance Laboratory Network (ARLN)



Antimicrobial Resistant Reportable Diseases

- *Candida auris* (Candidiasis)
- Carbapenemase-Producing, Carbapenem-Resistant *Enterobacterales* (CP-CRE). Reportable in MI starting 2018. [New 2023 Guidance](#)
 - **CP-CRE Case Surveillance**
 - Required case reporting to MDSS by healthcare providers and laboratories
 - Carbapenemase producing – carbapenem resistant *Enterobacterales* (All Genera), 2022
 - Case count for lifetime, 2023
 - **CP-CRE Isolate Surveillance**
 - Required isolate submission to BOL by laboratories for all genera of CP-CRE, 2022
- *Staphylococcus aureus*, Vancomycin Intermediate/Resistant (VISA/VRSA)
- “Unusual outbreak or occurrence”, e.g., hospital report of *Aspergillus* or allograft infection, etc.

2023 REPORTABLE DISEASES IN MICHIGAN – BY PATHOGEN

A Guide for Physicians, Health Care Providers and Laboratories

Report the following conditions to the Michigan Disease Surveillance System (MDSS) or local health department (see reverse) within 24 hours if the agent is identified by clinical or laboratory diagnosis. See footnotes for exceptions.

Report the unusual occurrence, outbreak or epidemic of any disease or condition, including healthcare-associated infections.

<p>Acute flaccid myelitis (1)</p> <p>Anaplasma phagocytophilum (Anaplasmosis)</p> <p>Arboviral encephalitides, neuro- and non-neuroinvasive:</p> <p>Chikungunya, Eastern Equine, Jamestown Canyon, La Crosse, Powassan, St. Louis, West Nile, Western Equine, Zika (6)</p> <p>Babesia microti (Babesiosis)</p> <p>Bacillus anthracis and B. cereus serovar anthracis (Anthrax) (4)</p> <p>Blastomyces dermatitidis (Blastomycosis)</p> <p>Bordetella pertussis (Pertussis)</p> <p>Borrelia burgdorferi (Lyme Disease)</p> <p>Brucella species (Brucellosis) (4)</p> <p>Burkholderia mallei (Glanders) (4)</p> <p>Burkholderia pseudomallei (Meliodiosis) (4)</p> <p>Campylobacter species (Campylobacteriosis)</p> <p>Candida auris (Candidiasis) (4)</p> <p>Carbapenemase Producing – Carbapenem Resistant Enterobacterales (CP-CRE): all genera (4)</p> <p>Chlamydia trachomatis (Trachoma, genital infections, Lymphogranuloma venereum (LGV)) (3, 6)</p> <p>Chlamydia psittaci (Psittacosis)</p> <p>Clostridium botulinum (Botulism) (4)</p> <p>Clostridium tetani (Tetanus)</p> <p>Coccidioides immitis (Coccidioidomycosis)</p> <p>Coronaviruses, Novel; including deaths and SARS-CoV-2 variant identification (SARS, MERS-CoV, SARS-CoV-2) (5)</p> <p>Corynebacterium diphtheriae (Diphtheria) (5)</p> <p>Coxiella burnetii (Q Fever) (4)</p> <p>Cronobacter sakazakii (4, blood or CSF only, from infants < 1 year of age)</p> <p>Cryptosporidium species (Cryptosporidiosis)</p> <p>Cyclospora species (Cyclosporiasis) (5)</p> <p>Dengue virus (Dengue Fever)</p> <p>Ehrlichia species (Ehrlichiosis)</p> <p>Encephalitis, viral or unspecified</p> <p>Escherichia coli, O157:H7 and all other Shiga toxin positive serotypes (including HUS) (5)</p> <p>Francisella tularensis (Tularemia) (4)</p> <p>Giardia species (Giardiasis)</p> <p>Guillain-Barre Syndrome (1)</p> <p>Haemophilus ducreyi (Chancroid)</p> <p>Haemophilus influenzae, sterile sites (5, submit isolates for serotyping for patients <15 years of age)</p> <p>Hantavirus</p> <p>Hemorrhagic Fever Viruses (4)</p> <p>Hepatitis A virus (Anti-HAV IgM, HAV genotype)</p> <p>Hepatitis B virus (HBsAg, HBeAg, anti-HBc IgM, HBV NAAT, HBV genotype; report all HBsAg and anti-HBs (positive, negative, indeterminate) for children ≤ 5 years of age) (6)</p> <p>Hepatitis C virus (all HCV test results including positive and negative antibody, RNA, and genotype tests) (6)</p> <p>Histoplasma capsulatum (Histoplasmosis)</p> <p>HIV tests including: reactive immunoassays including all analytes (e.g., Ab/Ag, TD1/TD2, WB, EIA, IA), detection tests (e.g., VL, NAAT, p24, genotypes), CD4 counts/percents; and all tests related to perinatal exposures) (2,6)</p> <p>Influenza virus (weekly aggregate counts)</p> <p>Pediatric influenza mortality, report individual cases (5)</p> <p>Novel influenza viruses, report individual cases (5, 6)</p> <p>Kawasaki Disease (1)</p>	<p>Legionella species (Legionellosis) (5)</p> <p>Leptospira species (Leptospirosis)</p> <p>Listeria monocytogenes (Listeriosis) (5, 6)</p> <p>Measles virus (Measles/Rubeola) (6)</p> <p>Meningitis: bacterial, viral, fungal, parasitic, and amebic</p> <p>Multisystem Inflammatory Syndrome in Children (MIS-C) and in Adults (MIS-A)</p> <p>Mumps virus</p> <p>Mycobacterium leprae (Leprosy or Hansen's Disease)</p> <p>Mycobacterium tuberculosis complex (Tuberculosis); report preliminary and final rapid test and culture results (4)</p> <p>Neisseria gonorrhoeae (Gonorrhea) (3, 6) (4, submit isolates from sterile sites only)</p> <p>Neisseria meningitidis, sterile sites (Meningococcal Disease) (5)</p> <p>Orthopox viruses, including: Smallpox, Mpox (4)</p> <p>Plasmodium species (Malaria)</p> <p>Poliovirus (Polio)</p> <p>Prion disease, including CJD</p> <p>Rabies virus (4)</p> <p>Rabies: potential exposure and post exposure prophylaxis (PEP)</p> <p>Rickettsia species (Spotted Fever)</p> <p>Rubella virus (6)</p> <p>Salmonella species (Salmonellosis) (5)</p> <p>Salmonella Paratyphi (Paratyphoid Fever): serotypes Paratyphi A, Paratyphi B (tartrate negative), and Paratyphi C (5)</p> <p>Salmonella typhi (Typhoid Fever) (5)</p> <p>Shigella species (Shigellosis) (5)</p> <p>Staphylococcus aureus Toxic Shock Syndrome (1)</p> <p>Staphylococcus aureus, vancomycin intermediate/resistant (VISA (5)/VRSA (4))</p> <p>Streptococcus pneumoniae, sterile sites</p> <p>Streptococcus pyogenes, group A, sterile sites, including Streptococcal Toxic Shock Syndrome (STSS)</p> <p>Treponema pallidum (Syphilis) (6)</p> <p>Trichinella spiralis (Trichinellosis)</p> <p>Varicella-zoster virus (Chickenpox) (6)</p> <p>Vibrio cholera (Cholera) (4)</p> <p>Vibrio species (Vibriosis: non-cholera species) (5)</p> <p>Yellow fever virus</p> <p>Yersinia enterocolitica (Yersiniosis) (5)</p> <p>Yersinia pestis (Plague) (4)</p>
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LEGEND

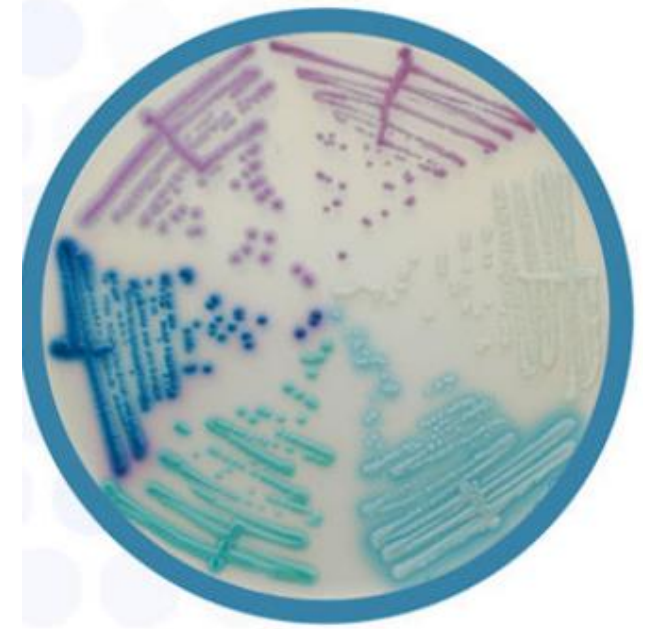
- (1) Reporting within 3 days is required.
 - (2) Report HIV labs electronically/by arrangement & case reports by MDHHS Form 1355. Report HIV genome sequence data only as Sanger sequences, or as consensus sequences for next generation sequencing.
 - (3) Sexually transmitted infection for which expedited partner therapy is authorized. See www.michigan.gov/hivsti for details.
 - (4) A laboratory shall immediately submit suspect or confirmed isolates, subcultures, or specimens from the patient being tested to the MDHHS Lansing laboratory.
 - (5) Isolate requested. Enteric: if an isolate is not available from non-culture based testing, the positive broth and/or stool in transport medium must be submitted to the MDHHS Lansing laboratory. Respiratory: Submit specimens, if available.
 - (6) Report pregnancy status, if available.
- Blue Bold Text = Category A Bioterrorism or Select Agent must be notified immediately to the MDHHS Laboratory (517-335-8063)

<https://www.michigan.gov/cdinfo>

2022 Brick Book and CD Lists

Candida auris Case Reporting Requirements

- Report any laboratory finding that meets either of the following criteria:
 - Detection of *C. auris* in a specimen using either **culture** or a **culture-independent diagnostic test (CIDT)** (e.g., Polymerase Chain Reaction [PCR])
 - Detection of an organism that commonly represents a *C. auris* misidentification in a specimen by culture (i.e., *Candida haemulonii*)
- Laboratories **shall immediately submit confirmed or suspect *C. auris*** isolates, subcultures, or specimens to the MDHHS BOL in Lansing
- Case Status: Confirmed- Detection of *C. auris* from any body site using either culture or a culture independent diagnostic test (CIDT)



Lab Results					
Report Date (mm/dd/yyyy)	Test Name	Reported Test Name/Test Result		Specimen	Collection Date (mm/dd/yyyy)
03/25/2022	Fungal Identification	Fungus identified/null	Candida auris///	Ear sample	05/20/2021
03/25/2022	Fungus identified	Fungus identified/Fungal Cultural Human	Candida auris///		05/20/2021
06/02/2021	Culture and Gram Stain Ear	BACTERIA IDENTIFIED: PRID:PT:EAR:NOM:AEROBIC CULTURE/Culture and Gram Stain Ear	Candida auris///	Ear sample	05/20/2021
05/20/2021	Bacteria Identification [Presence] in Isolate by Culture	Bacteria Identification [Presence] in Isolate by Culture	//with normal skin flora CANDIDA AURIS Quantity of Organism: MODERATE/		05/24/2021



CP-CRE Case Reporting

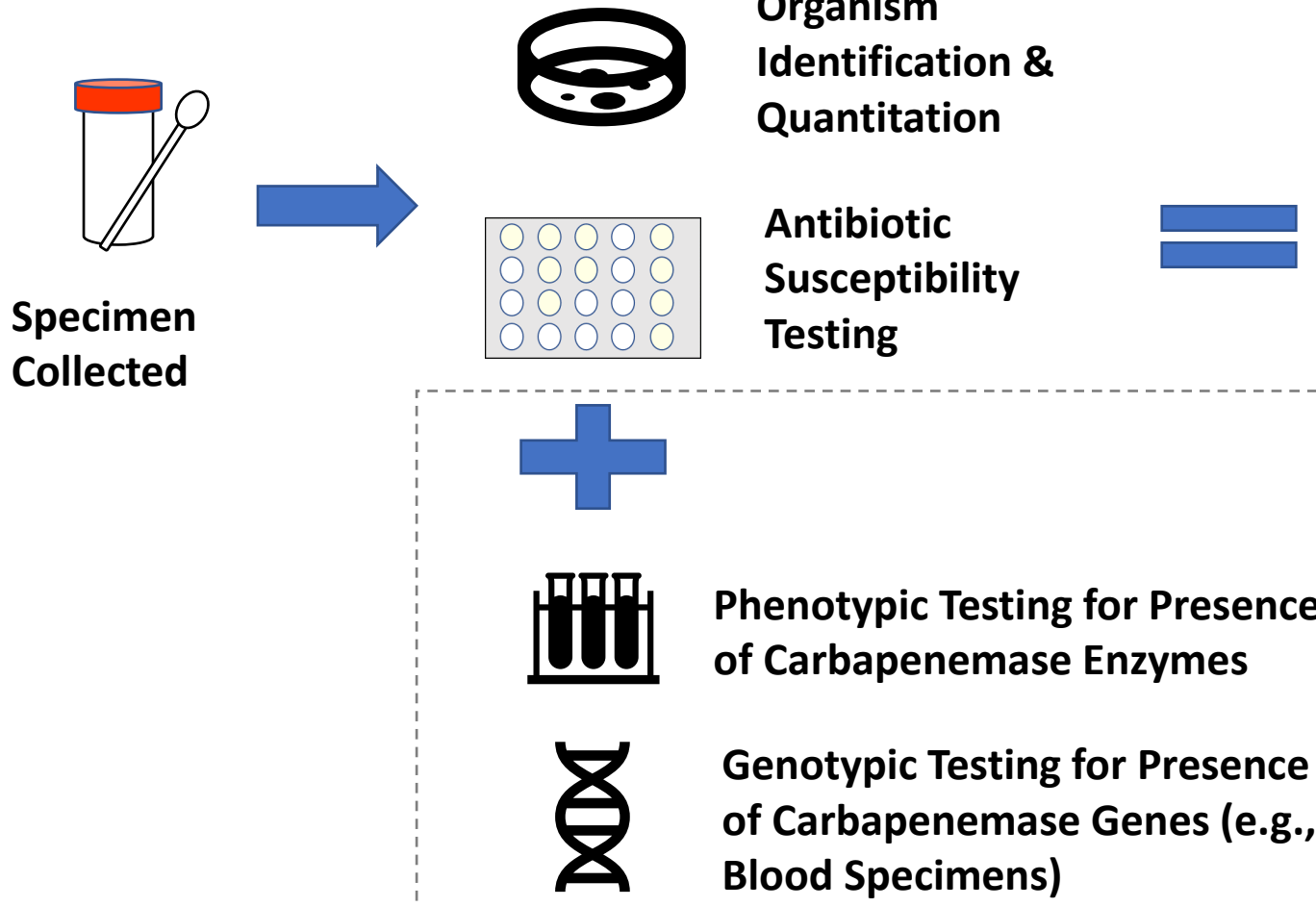


Healthcare Providers **must report cases to MDSS** and

Laboratories **must submit isolates to MDHHS BOL** (for confirmatory testing) for any of the following:

- **Diagnosis:** Healthcare record contains a diagnosis of **Carbapenemase-producing Carbapenem-resistant Enterobacterales (CP-CRE)**, with KPC, NDM, OXA-48, IMP, VIM or a novel carbapenemase
- **Phenotypic test:** Any Enterobacterales isolate positive for carbapenemase production by a phenotypic test (e.g., Carba NP, CIM, mCIM)
- **Molecular test:** Any Enterobacterales isolate positive for a known carbapenemase resistance mechanism by a recognized molecular test (e.g., PCR, Expert Carba-R) for *Klebsiella pneumoniae* carbapenemase (**KPC**), New Delhi metallo- β -lactamase (**NDM**), Verona integron encoded metallo- β -lactamase (**VIM**), Imipenemase metallo- β -lactamase (**IMP**), Oxacillinase-48 (**OXA-48**)
- **Antimicrobial Susceptibility Testing MIC Criteria:** If testing for carbapenemase production (phenotypic) or carbapenemase resistance mechanism (molecular test) was not conducted or reported, any Enterobacterales isolate with a **minimum inhibitory concentration (MIC)** for any one carbapenem antibiotic:
 - **≥ 4 mcg/ml for meropenem, imipenem, or doripenem, or ≥ 2 mcg/ml for ertapenem**
 - *Morganella*, *Proteus*, *Providencia* spp. may have intrinsic resistance to imipenem. Only those isolates that are resistant to 1 or more carbapenems other than imipenem should be reported.

Clinical Microbiology CP-CRE Laboratory Testing



Results

📍 Culture, Urine

📍 Culture, Urine

Status: Final result Vis

Next appt: None

Specimen Information: Urine, Clean Catch

Culture, Urine >100,000 CFU/ml *Enterobacter cloacae*, CRE, MDR !
Other - This isolate resulted CRE Non Carbapenemase producer by PCR.
MDR - This isolate is resistant to a carbapenem(s) (CRE). Initiate contact precautions. Consider Infectious Diseases consult.

Susceptibility

Enterobacter cloacae, CRE, MDR (1)

Antibiotic	MIC	Interpretation
Cefazolin	>=64	Resistant
Cefepime	8	Intermediate
Ceftriaxone	>=64	Resistant
Ertapenem	4	Resistant
Gentamicin	<=1	Susceptible
Levofloxacin	<=0.12	Susceptible
Meropenem	0.5	Susceptible
Nitrofurantoin	64	Intermediate
Tobramycin	<=1	Susceptible
Trimethoprim/Sulfa	<=20	Susceptible

Specimen Collected: 08/09/22 03:40

Last Resulted: 08/17/22 08:28

MDHHS BOL Laboratory Antimicrobial Resistance Confirmation Testing

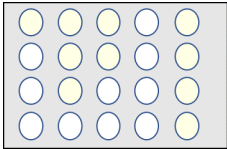
Clinical
Micro Lab



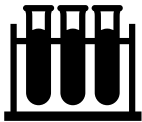
Pure
Isolate



Organism ID Confirmation



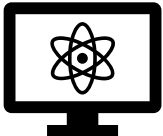
Antibiotic Susceptibility Testing



Phenotypic Testing for Presence of
Carbapenemase Enzymes (mCIM Test)



Genotypic Testing for Presence of
Carbapenemase Genes (PCR)



Whole Genome Sequencing

Antimicrobial Resistance Confirmation (ARC)

Gram Stain

Gram negative bacilli

Culture Results

Confirmed as *Klebsiella pneumoniae*

Identification Performed by MALDI-TOF.

Antimicrobial Susceptibility Results

		<i>Klebsiella pneumoniae</i>	
		MIC - Interpretation	
Amikacin	<=4	S	
Aztreonam	>16	R	
Cefepime	4	SDD	
Cefotaxime	32	R	
Ceftazidime	>16	R	

Modified Carbapenem Inactivation Method

Positive

Phenotypic test

Modified Carbapenem Inactivation Method (mCIM) screen positive - this isolate demonstrates carbapenemase production. The clinical efficacy of the carbapenems has not been established for treating infections caused by Enterobacteriaceae and Pseudomonas aeruginosa that test carbapenem susceptible but demonstrate carbapenemase production in vitro. ISOLATES THAT ARE mCIM POSITIVE SHOULD BE CONSIDERED RESISTANT TO ALL CARBAPENEMS REGARDLESS OF MIC. MIC REPORTED FOR EPIDEMIOLOGIC PURPOSES ONLY.

PCR Result

KPC (bla-KPC) gene DNA Detected

Molecular test

NDM-1 (bla-NDM-1) gene DNA Not Detected

OXA-48 (bla-OXA-48 like) gene DNA Not Detected

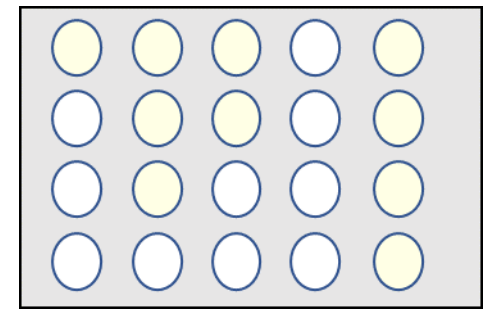
VIM (bla-VIM) gene DNA Not Detected

KPC, NDM, OXA-48, and VIM are the most common carbapenemases in the United States, however there are other less common carbapenemases and other mechanisms of carbapenemase resistance not detected by this PCR assay.

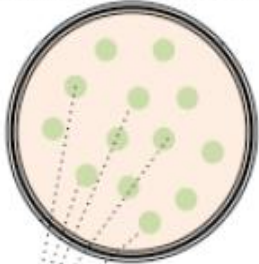
IMP PCR Result

IMP (bla-IMP) gene DNA Not Detected

Antimicrobial Susceptibility Testing



1. Obtain isolated colonies of bacterial strain to test.



2. Combine 4-5 colonies and culture overnight in rich media broth.



Broth dilution method for measuring minimum inhibitory concentration of antibiotics

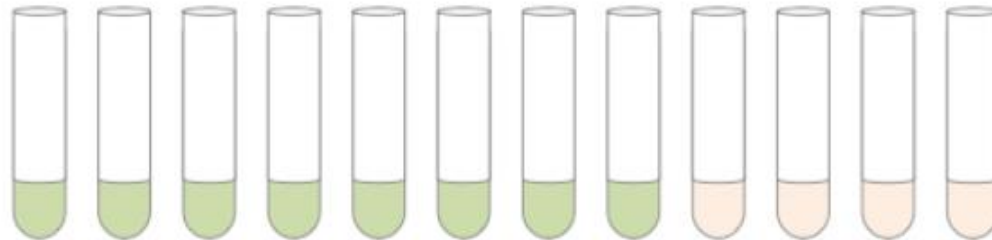
3. After overnight incubation shown at left, add rich broth with appropriate dilution series of test antibiotic to test tubes. Example concentrations (mg/L) are shown below. Inoculate bacteria to a final density of 5×10^5 cfu/ml.



4. Plate aliquot of growth control (i.e., no antibiotic added) to verify cfu/ml counts of viable bacteria. Incubate overnight and count colonies.



5. After overnight incubation, check cultures for growth. The MIC is the lowest concentration of antibiotic that prevents visible growth. In this example, the MIC is 64 mg/L.



Dilution testing is used to quantitatively determine the minimal concentration (mg/ml) of antimicrobial agent to inhibit or kill the bacteria.

- Two-fold dilutions of the antimicrobial agent is added directly to a micro-broth panel.
- The lowest level that inhibits the visible growth of the organism is considered the **Minimum Inhibitory Concentration (MIC)**.

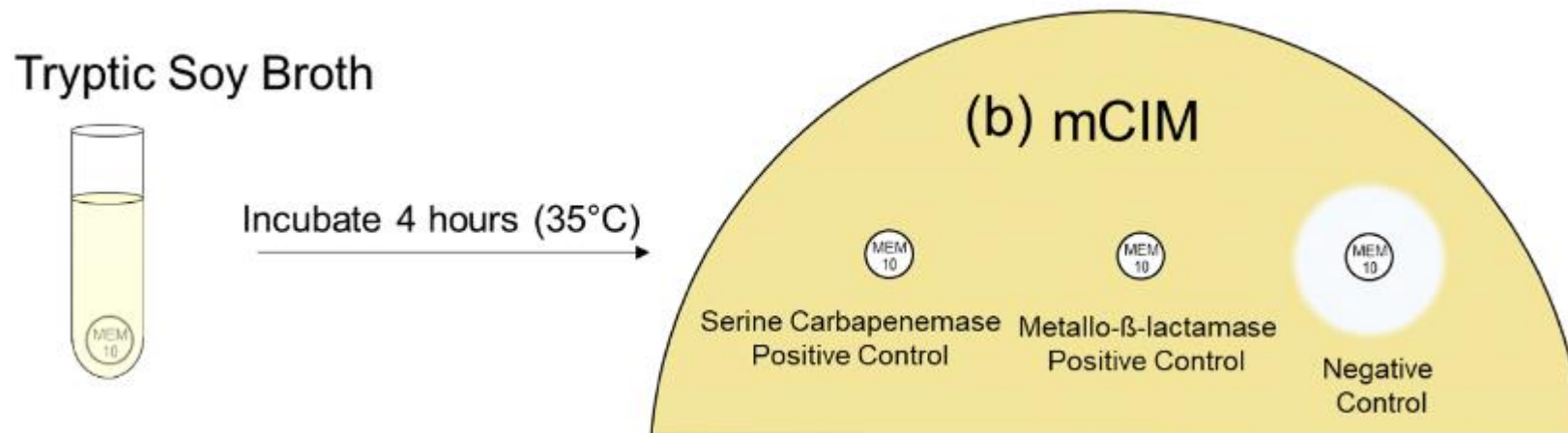
For CP-CRE screening with no additional testing:

- any Enterobacterales isolate with a minimum inhibitory concentration criteria for any one carbapenem *may* indicate carbapenemase activity:
 - ≥ 4 mcg/ml for meropenem,
 - ≥ 4 mcg/ml for imipenem,
 - ≥ 4 mcg/ml for doripenem, or
 - ≥ 2 mcg/ml for ertapenem

Phenotypic Test

- Reliable and simple test to determine if the organism produces any type of carbapenemase enzyme that can break down carbapenem antibiotics, conferring resistance to carbapenem antibiotics.
- Positive result confirms that the organism has carbapenemase activity present – carbapenemase producing

Modified carbapenem inactivation method (mCIM)



Molecular Test



- Molecular tests for CP-CRE identify the specific carbapenemase gene that encodes for a carbapenemase enzyme, thereby determining the organism's mechanism of resistance. These tests will only detect gene targets available on the specified panel/probe of the assay.
- Results will indicate which gene in the panel was detected or not detected.
- Common carbapenemase genes include KPC, NDM, OXA-48, IMP, and VIM



CP-CRE Case Status/Classification

1. Confirmed CP-CRE

- ✓ *Enterobacterales* organism or no organism recovered from a molecular carbapenemase screening specimen
- ✓ Positive phenotypic test (e.g., mCIM, Carba NP, etc.) **OR**
- ✓ Positive molecular test (e.g., PCR, Cepheid Xpert, etc.) – carbapenem resistance mechanism detected: KPC, NDM, VIM, IMP, OXA-48, etc.

2. Suspect CP-CRE

- ✓ *Enterobacterales* organism
- ✓ Resistance to at least one carbapenem on susceptibility testing - MIC criteria **≥4 mcg/ml for meropenem, imipenem, or doripenem, or ≥ 2 mcg/ml for ertapenem**
- ✓ No phenotypic or molecular testing done (isolate should be submitted to BOL)

3. Not a Case

- ✓ Organism not *Enterobacterales*
- ✓ All carbapenems are susceptible (MIC don't match criteria)
- ✓ Negative for phenotypic and molecular tests, if conducted, regardless of MIC criteria.



CP-CRE Case Classification Flowchart

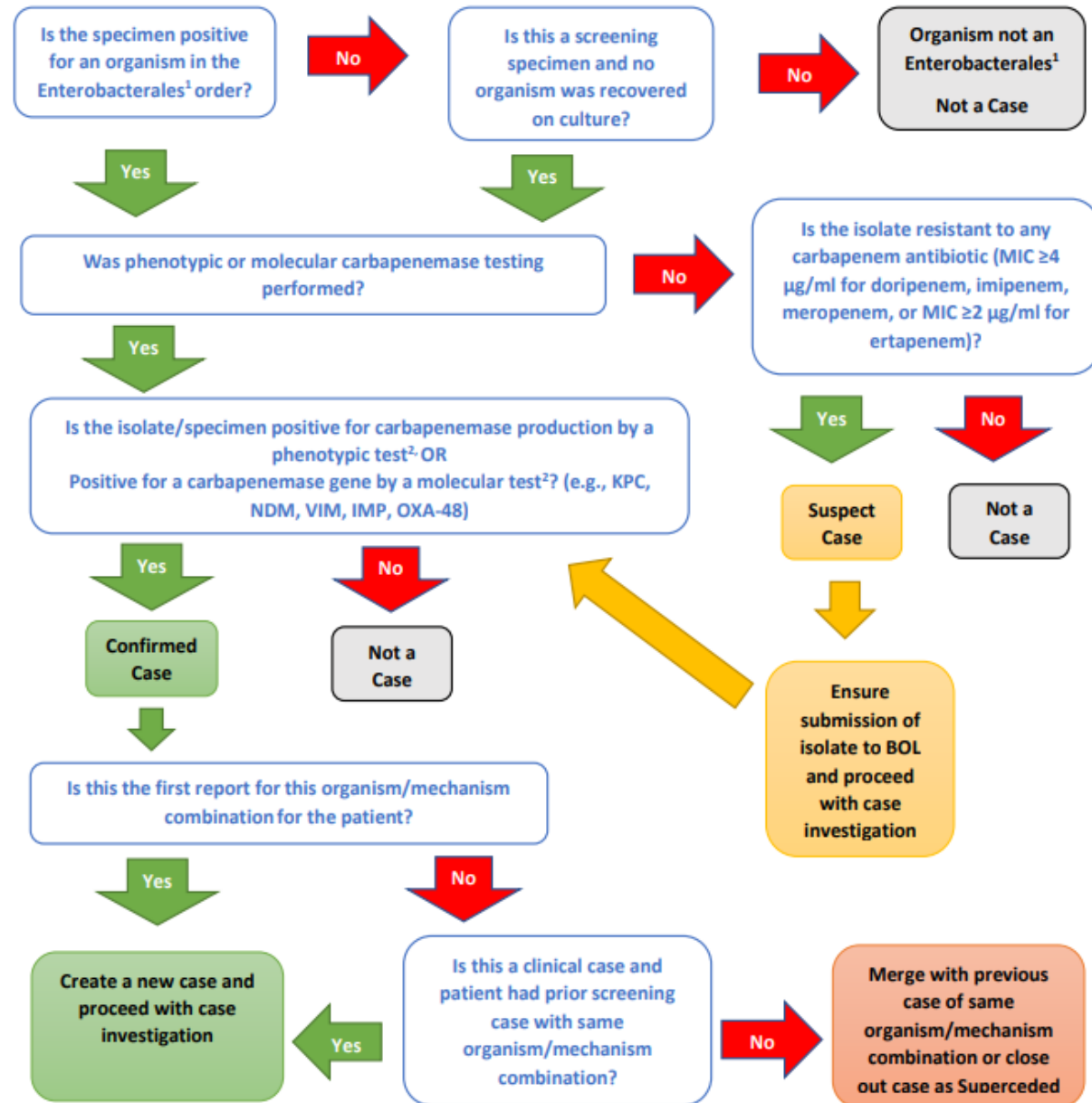
NEW for 2023

MDHHS
[CP-CRE Case Reporting and Investigation Guidance, 2023](#)

- Comprehensive guide to reporting, investigation, and MDSS documentation of CP-CRE for LHDS, Infection Prevention, and labs.

CP-CRE Case Reporting and Investigation Guidance

Appendix A: MDSS Reporting and Case Status/Classification Flowchart



1- See Table 1. Enterobacterales, all genera

2- See Table 2. Phenotypic and Molecular Test Methods for CP-CRE

MDHHS BOL ELR Lab Report

Interpretation – Confirmed CP-CRE

Lab Results					
Report Date (mm/dd/yyyy)	Test Name	Reported Test Name/Test Result		Specimen	Collection Date (mm/dd/yyyy)
01/06/2021	Culture Results	Bacteria identified/null	Klebsiella pneumoniae///	Other	12/20/2020
01/06/2021	Antimicrobial Susceptibility Results	Doripenem/null Ertapenem/null Imipenem/null Meropenem/null	///> 2 ///> 4 ///> 8 ///> 8		12/20/2020
01/06/2021	Modified Carbapenem Inactivation Method	Carbapenemase/null	Positive///		12/20/2020
01/06/2021	PCR Result	bla(KPC) gene/null Bacterial carbapenem resistance blaNDM gene/null Bacterial carbapenem resistance blaOXA-48-like gene/null Bacterial carbapenem resistance blaVIM gene/null	KPC (bla-KPC) gene DNA Not Detected/// NDM-1 (bla-NDM-1) gene DNA Detected/// OXA-48 (bla-OXA-48 like) gene DNA Not Detected/// VIM (bla-VIM) gene DNA Not Detected///		12/20/2020
01/06/2021	IMP PCR Result	Bacterial carbapenem resistance blaIMP gene/null	IMP (bla-IMP) gene DNA Not Detected///		12/20/2020
01/06/2021	Carbapenem resistance genes	Carbapenem resistance genes/ARC	Klebsiella pneumoniae///		12/20/2020
01/05/2021	Culture Results	Bacteria identified/	Klebsiella pneumoniae///	Other	12/20/2020
01/05/2021	PCR Result	bla(KPC) gene/ Bacterial carbapenem resistance blaNDM gene/ Bacterial carbapenem resistance blaOXA-48-like gene/ Bacterial carbapenem resistance blaVIM gene/	KPC (bla-KPC) gene DNA Not Detected/// NDM-1 (bla-NDM-1) gene DNA Detected/// OXA-48 (bla-OXA-48 like) gene DNA Not Detected/// VIM (bla-VIM) gene DNA Not Detected///		12/20/2020

Antimicrobial Resistance Confirmation (ARC)

Gram Stain

Gram negative bacilli

Culture Results

Confirmed Identification by MALDI-TOF - Klebsiella pneumoniae

Antimicrobial Susceptibility Results

	Klebsiella pneumoniae	
	MIC - Interpretation	
Aztreonam	>16	R
Cefepime	>16	R

Modified Carbapenem Inactivation Method

Positive

Modified Carbapenem Inactivation Method (mCIM) screen positive - this isolate demonstrates carbapenemase production. The clinical efficacy of the carbapenems has not been established for treating infections caused by Enterobacteriaceae and Pseudomonas aeruginosa that test carbapenem susceptible but demonstrate carbapenemase production in vitro. ISOLATES THAT ARE mCIM POSITIVE SHOULD BE CONSIDERED RESISTANT TO ALL CARBAPENEMS REGARDLESS OF MIC. MIC REPORTED FOR EPIDEMIOLOGIC PURPOSES ONLY.

PCR Result

KPC (bla-KPC) gene DNA Not Detected

NDM-1 (bla-NDM-1) gene DNA Detected

IMP PCR Result

IMP (bla-IMP) gene DNA Not Detected

16S rRNA Sequencing, PCR, and MALDI-TOF tests were developed and their performance characteristics determined by the Michigan Department of Health and Human Services (MDHHS). They have not been cleared or approved by the U.S. Food and Drug Administration (FDA). The FDA has determined that such clearance or approval is not necessary if performance characteristics are verified at the testing laboratory.

Initial screening for carbapenemase genes performed using Cepheid GeneXpert which has been FDA approved for this testing.

MDHHS BOL ELR Lab Report Interpretation – Not a Case, CP-CRE

Date Collected	07/22/2021	Patient Last Name	[REDACTED]
Time Collected	1014	Patient First Name	[REDACTED]
Date Received	07/29/2021	Patient DOB	[REDACTED]
Specimen Type	SPUTUM	Submitter Patient ID	[REDACTED]
		Gender	[REDACTED]
		Physician	[REDACTED]
		Submitter Identifier	P51690
		Reason for Test	DIAGNOSIS

TEST RESULTS

Antimicrobial Resistance Confirmation (ARC)

Gram Stain

Direct Gram Stain Not Done

Culture Results

Confirmed Identification by MALDI-TOF - Enterobacter cloacae complex

Modified Carbapenem Inactivation Method

Negative

Modified Carbapenem Inactivation Method (mCIM) screen negative - not all carbapenemase-producing isolates of Enterobacteriaceae and Pseudomonas aeruginosa are mCIM positive.

16S rRNA Sequencing, PCR, and MALDI-TOF tests were developed and their performance characteristics determined by the Michigan Department of Health and Human Services (MDHHS). They have not been cleared or approved by the U.S. Food and Drug Administration (FDA). The FDA has determined that such clearance or approval is not necessary if performance characteristics are verified at the testing laboratory.

Initial screening for carbapenemase genes performed using Cepheid GeneXpert which has been FDA approved for this testing.

Lab Reports						Help
Date Received	Collection Date	Test Name (* Case Associated)	Result	Electronic		
08/11/2021	07/22/2021	Culture Results	Enterobacter cloacae complex	Yes	View	
08/11/2021	07/22/2021	Modified Carbapenem Inactivation Method	Negative	Yes	View	
08/11/2021	07/22/2021	Carbapenem resistance genes	Enterobacter cloacae complex	Yes	View	
		Modified Carbapenem Inactivation				


Duplicate CP-CRE Case Reports?

If a person is first classified as a clinical case, and later screening reports the same organism/carbapenemase combination, **they are counted only once**.

Example: Patient A has a sputum culture that is positive for KPC *K. pneumoniae*.

Later, Patient A is included in a CP-CRE screening Point Prevalence Survey (PPS) and their rectal swab is KPC positive by PCR. *K. pneumoniae* is eventually cultured from the same rectal swab specimen.


Patient A would be counted only once, as a clinical KPC+ *K. pneumoniae* case for the initial sputum culture, even if future results are positive for the same organism/carbapenemase combination from a different specimen source.

Laboratory Results	Interpretation 	Action
Sputum culture 1/12/2023 KPC+ <i>Klebsiella pneumoniae</i>	New Confirmed CP-CRE case for Patient A, case #1	Report as a Confirmed clinical case Organism: <i>K. pneumoniae</i> Gene: KPC
Rectal swab 2/13/2023 KPC+ by PCR KPC+ <i>Klebsiella pneumoniae</i> by subsequent culture	Positive screening for same organism/mechanism as case #1, initial clinical case. Not a new case for Patient A.	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superseded

Duplicate CP-CRE Case Reports?

A person first classified as a screening case can be later counted as a clinical case with the same organism/carbapenemase combination. **This is the only scenario that the same organism/carbapenemase combination can be counted twice for the same person.**

Example: A rectal swab from Patient A results in KPC+ *E. coli*. Patient A is later at a hospital where a blood specimen tests positive for KPC *E. coli*. Patient A would be reported as a KPC+ *E. coli* screening and clinical case.

Laboratory Results	Interpretation 	Action
Rectal swab 1/10/2023 KPC+ Escherichia coli	New Confirmed CP-CRE case #1	Report as a Confirmed Screening Case Organism: <i>E. coli</i> Gene: KPC
Blood culture 2/12/2023 KPC+ Escherichia coli	Positive clinical specimen for same organism/carbapenemase as case #1. New Confirmed CP-CRE case #2	Report as a Confirmed Clinical Case Organism: <i>E. coli</i> Gene: KPC

Tips for CP-CRE Reporting

- **Review the MDSS case information provided**
 - Person History tab may provide a list of prior reports
 - Notes tab may show lab reports attached
 - Lab Reports tab shows electronic reports and any manual lab entries
- **Confirm the organism identification**
 - Enterobacterale - Enterobacterales is an order of different types of bacteria which includes *Escherichia*, *Klebsiella*, *Enterobacter*, *Salmonella*, *Shigella*, *Citrobacter*, *Yersinia*, etc.
- **Review carbapenem Susceptibility testing MIC values**
 - Doripenem, imipenem, or meropenem $\geq 4 \mu\text{g/ml}$; or ertapenem $\geq 2 \mu\text{g/ml}$
 - If there are no MIC values reported (e.g., “Resistant”) or no carbapenems reported in MDSS, call the laboratory and ask to speak to a bench technologist
 - If there are only MIC values reported, ensure isolate is submitted to BOL for confirmatory testing; if isolate was submitted, wait a few days from submission date to check for electronic BOL lab report
- **Check for phenotypic carbapenemase testing**
 - ‘Carbapenemase positive’ or ‘Carbapenemase negative’
 - Confirm the method used: mCIM, CarbaNP, MBL test
- **Check for molecular carbapenemase testing for resistance mechanisms**
 - KPC, NDM, OXA-48, VIM, IMP “Detected” or “Not Detected”



Case Investigation Forms

“Case Report Form (CRF)” or “Case Detail Form”, or “Case Investigation Form”

- Sections
 - Investigation Information
 - Patient Information
 - Demographics
 - Referral Information
 - Laboratory Testing and Microbiology Information
 - Clinical Information
 - Other Information
 - Case Notes
 - Lab Results

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CP-CRE Case Report

Carbapenemase-Producing Carbapenem-Resistant Enterobacteriaceae (CP-CRE)

Michigan Department of Health and Human Services

Communicable Disease Division

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Candida auris Case Report

Michigan Department of Health and Human Services

Communicable Disease Division

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Investigation Information

Investigation ID	Onset Date (mm/dd/yyyy)	Diagnosis Date (mm/dd/yyyy)	Referral Date (mm/dd/yyyy)	Case Entry Date (mm/dd/yyyy)
Investigation Status Active	Case Status <input type="radio"/> Confirmed <input type="radio"/> Probable			<input type="radio"/> Confirmed - Non Resident <input type="radio"/> Suspect <input type="radio"/> Not a Case <input type="radio"/> Non-Michigan Case <input type="checkbox"/> State Prison Case
Patient Status Alive	Patient Status Date (mm/dd/yyyy)	Case Disposition	Case Updated Date (mm/dd/yyyy)	Case Completion Date (mm/dd/yyyy)
Date of Death (mm/dd/yyyy)	Investigator First Name:Last Name:		Part of an outbreak?	Outbreak Name
Case Type: <input type="radio"/> Clinical Case <input type="radio"/> Colonization/Screening Case				
Clinical Candida auris Case Only: Was patient previously counted as a colonization/screening case? <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown If patient was previously counted as a colonization/screening case, please provide the related case ID(s)				


Patient Information

Patient ID	First	Last	Middle
Street Address			

Collapse all

ion

al Date (d/yyyy)	Case Entry Date (mm/dd/yyyy)
a Case -Michigan Case	<input type="checkbox"/> State Prison Case
se Updated Date (m/dd/yyyy)	Case Completion Date (mm/dd/yyyy)
rt of an outbreak?	Outbreak Name
Unknown	
	Middle



Candida auris Laboratory Testing

- **Laboratory Testing information is required to determine case classification**

- Date collected
- Specimen source
- Test Type



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Candida auris Case Report

Michigan Department of Health and Human Services

Communicable Disease Division

+

Demographics

+

Referral Information

-

Laboratory Testing and Microbiology Information

Type of facility where specimen was collected:

☐ Acute Care Hospital ☐ Long-Term Acute Care Hospital ☐ Long-Term Care Facility ☒ Outpatient ☐ Other

☐ Autopsy ☐ Unknown

Date Specimen Collected (mm/dd/yyyy)

County of the facility where specimen collected:

Facility where specimen collected:

05/20/2021

Oakland

For Clinical Case:

Specimen Source:

Other source, specify:

Other

Ear Drainage

For Colonization/Screening Case:

Screening swab anatomical site:

Other site:

Clinical Lab Specimen ID (unique isolate No.):

Bureau of Labs Specimen ID:

WGS Accession ID:

Test Type:

Test Method (manufacturer/brand, type of PCR, etc.):

Result:

MALDI-TOF

Bruker

☒ Detected ☐ Not Detected ☐ Indeterminate

Other test, specify:

Test Type:

Test Method (manufacturer/brand, type of PCR, etc.):

Result:

☐ Detected ☐ Not Detected ☐ Indeterminate

Other test, specify:

Test Type:

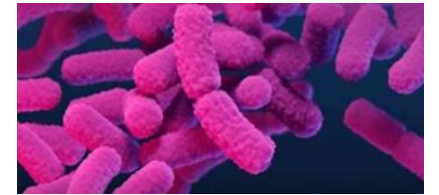
Test Method (manufacturer/brand, type of PCR, etc.):

Result:

☐ Detected ☐ Not Detected ☐ Indeterminate

Other test, specify:

CP-CRE Laboratory Testing



- **Laboratory Testing information is required to determine case classification**

- Date collected
- Specimen source
- Organism
- **Susceptibility test: MIC**
 - Enter actual numerical value and interpretation - “R”, “S”, or “I”
- **Phenotype test: Carbapenemase testing**
 - Enter test type (e.g., mCIM, CarbaNP) and result, or “Not Tested”
- **Molecular test: Resistance mechanism-gene testing**
 - Enter test type (e.g. PCR, Carba-R) and result, or “Not Tested”
- BOL Specimen ID if applicable

Organism: <input type="radio"/> <i>Klebsiella aerogenes</i> <input type="radio"/> <i>Klebsiella pneumoniae</i> <input type="radio"/> <i>Enterobacter cloacae</i> <input type="radio"/> <i>Escherichia coli</i> <input type="radio"/> Other, specify: <input type="text"/>		
<input type="radio"/> <i>Klebsiella oxytoca</i> <input type="radio"/> <i>Klebsiella, other</i> <input type="radio"/> <i>Enterobacter, other</i> <input type="text"/>		
Was Antimicrobial Susceptibility Testing performed? <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown		
Antimicrobial Susceptibility Testing Results:		
Antimicrobial	Minimum Inhibitory Concentration (MIC) (ug/ml)	Interpretation (S, susceptible; I, Intermediate; R, resistant)
Doripenem	<input type="text"/>	<input type="text"/>
Ertapenem	<input type="text"/>	<input type="text"/>
Imipenem	<input type="text"/>	<input type="text"/>
Meropenem	<input type="text"/>	<input type="text"/>
Phenotype Tests: <input type="text"/> If Other, specify: <input type="text"/> Result: <input type="radio"/> Positive <input type="radio"/> Negative <input type="radio"/> Indeterminate		
Molecular Tests: <input type="text"/> If Other, specify: <input type="text"/> Result: <input type="radio"/> Positive <input type="radio"/> Negative <input type="radio"/> Indeterminate		
Resistance Mechanism for Carbapenemase Testing	Response	
KPC	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
NDM	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
VIM	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
IMP	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
OXA-48	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
OXA-23	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
Other, specify <input type="text"/>	<input type="radio"/> Detected <input type="radio"/> Not detected <input type="radio"/> Not tested <input type="radio"/> Invalid	
Clinical Lab Specimen ID (unique isolate No.): <input type="text"/>	Bureau of Labs Specimen ID: <input type="text"/>	WGS Accession ID: <input type="text"/>

Clinical Info for CP-CRE and *Candida auris*

- Healthcare exposures
 - Acute care, long-term care
- Travel
 - Location
 - Healthcare abroad
 - Very important for confirmed NDM, OXA-48, IMP, or VIM cases

Travel History			
Does the patient have a history of Travel outside the USA in the last 12 months? <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, please indicate the country and dates of travel			
Country:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Country:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Country:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Has the patient received Healthcare outside the USA within the last 12 months? <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, what Country: <input type="text"/>			
Has the patient received Healthcare outside the state of Michigan within the last 12 months? <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, what State: <input type="text"/>			

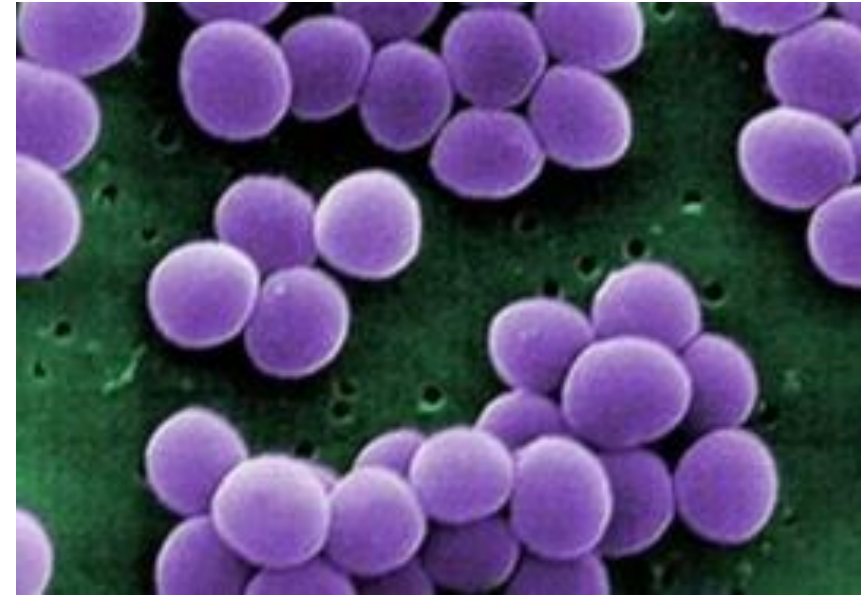
Clinical Information			
Date of Patient Admission or Presentation (mm/dd/yyyy)		Date Patient was placed in Contact Precautions/Isolation (if an inpatient) (mm/dd/yyyy)	
<input type="text"/>		<input type="text"/>	
Patient Admitted/Presented From:			
<input type="radio"/> Long-Term Care/Skilled Nursing Facility		<input type="radio"/> Outside Acute Care Hospital	<input type="radio"/> Home
<input type="radio"/> Long-Term Acute Care Hospital		<input type="radio"/> Unknown	<input type="radio"/> Other, specify <input type="text"/>
Date of Patient Discharge (mm/dd/yyyy)		Was information on CRE status shared with transferring agency and admitting facility:	
<input type="text"/>		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown	
Patient Discharged to:			
<input type="radio"/> Long-Term Care/Skilled Nursing Facility		<input type="radio"/> Outside Acute Care Hospital	<input type="radio"/> Home
<input type="radio"/> Long-Term Acute Care Hospital		<input type="radio"/> Unknown	<input type="radio"/> Other, specify <input type="text"/>
Has Patient previously been hospitalized in an Acute Care Hospital in the last 90 days: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, please indicate the facility name and dates of stay (if known)			
Facility:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Has Patient been admitted to a Long-Term Acute Care Hospital in the last 90 days: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, please indicate the facility name and dates of stay (if known)			
Facility:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Has Patient been admitted to a Long-Term Care Facility (e.g., nursing home, SNF) in the last 90 days: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown			
If Yes, please indicate the facility name and dates of stay (if known)			
Facility:	Dates:	From	To
<input type="text"/>	(mm/dd/yyyy)	<input type="text"/>	<input type="text"/>
Indwelling Devices (in place within 2 calendar days of specimen collection):			
Central Venous Line: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown		Mechanical Ventilation: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown	
Urinary Catheter: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown		Wound VAC (vacuum-assisted closure): <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Unknown	

VISA and VRSA

Vancomycin-intermediate *Staphylococcus aureus* (VISA)

Vancomycin-resistant *Staphylococcus aureus* (VRSA)

- Vancomycin is a critical antibiotic for the treatment of MRSA
- Requires a rapid and aggressive containment response
- 16 U.S. cases to date
 - Primarily in MI and DE
 - Last identified in 2021 in MI & NC (first cases since 2015!)



Vancomycin-resistant *Staphylococcus aureus* (VRSA)

- Thought to result from MRSA containing a pSK41-type plasmid and VRE containing *vanA* encoded on an Inc18-like plasmid
 - All 16 cases were *vanA* +
- Classified based on minimum inhibitory concentration (MIC) on susceptibility test

Vancomycin-susceptible *S. aureus* (VSSA)

- Vancomycin MIC ≤ 2 $\mu\text{g/ml}$

Vancomycin-intermediate *S. aureus* (VISA)

- Vancomycin MIC = 4-8 $\mu\text{g/ml}$.

Vancomycin-resistant *S. aureus* (VRSA)

- Vancomycin MIC ≥ 16 $\mu\text{g/ml}$.

Note: The breakpoints for S. aureus and vancomycin differ from those for other Staphylococcus species. (2015 CLSI M100-S25).

Lab Reports						Help
Date Received	Collection Date	Test Name (* Case Associated)	Result	Electronic		
06/21/2021	06/09/2021	Antimicrobial Susceptibility Results *	> 128	Yes	View	
06/21/2021	06/09/2021	vanA PCR Result *	vanA gene Detected	Yes	View	
06/21/2021	06/09/2021	Bacteria identified *	vanA gene Detected	Yes	View	

MDSS VRSA Case Investigation

- Report requires extensive case information
- Reports of suspected VRSA cases
 - Often mixed cultures of VRE and MRSA:
 - Ask laboratories to re-streak for purity and repeat AST
 - *S. aureus* isolates with vancomycin MICs ≥ 4 $\mu\text{g/ml}$ should be confirmed by a validated method and infection control should be notified
 - *S. aureus* isolates with a vancomycin MICs of ≥ 8 $\mu\text{g/ml}$ should be submitted to health departments and/or CDC for confirmation by a reference method
 - Notify health departments
- Ask facilities to save any MRSA and VRE isolates
- Patients with suspected VRSA should be place in isolation and contact precautions while awaiting results

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Vancomycin-Resistant Staphylococcus aureus (VRSA)

Michigan Department of Health and Human Services

Communicable Disease Division

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+	Investigation Information
+	Patient Information
+	Demographics
+	Referral Information
+	Referral Information Continued
+	Facility Information (at time of referral)
+	Isolate Information
+	Clinical Information
+	Clinical Information cont.
+	Clinical Information cont.
+	Other Information
+	Case Notes

Questions?

Contact:

[MDHHS SHARP Unit
Staff](#)

